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LogoClim: WorldClim in NetLogo

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Software

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Summary

`LogoClim` is a NetLogo model for simulating and visualizing global climate conditions. It allows researchers to integrate high-resolution climate data into agent-based models, supporting reproducible research in ecology, agriculture, environmental sciences, and other fields that rely on climate data.

The model uses raster data to represent climate variables such as temperature and precipitation over time. It incorporates historical data (1951-2024) and future climate projections (2021-2100) derived from global climate models under various Shared Socioeconomic Pathways (SSPs) (O'Neill et al., 2017). All climate inputs come from the WorldClim 2.1 project, a widely used source of high-resolution climate datasets (Fick & Hijmans, 2017), available for academic and other non-commercial use.

`LogoClim` follows the FAIR Principles for research software (Barker et al., 2022) and is openly available on the CoMSES Network and GitHub. Figure 1 and Figure 2 illustrate the model interface and functionality. See the `Logônia` model (Vartanian et al., 2026) for an example of its integration into a full NetLogo simulation.

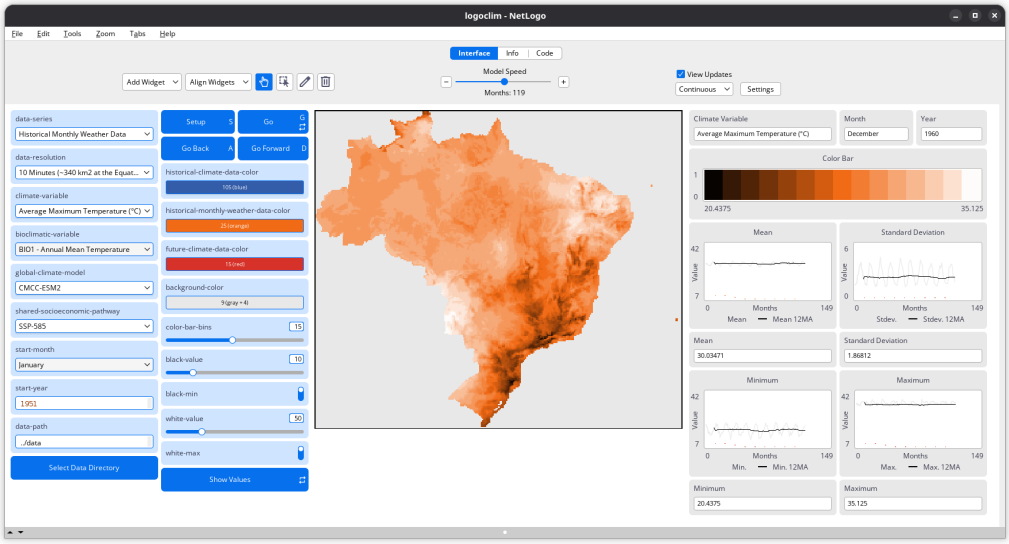

Figure 1: LogoClim Graphical User Interface: Brazil.

Statement of need

The lack of reproducibility is a major concern in science (Baker, 2016), including in computational research (Peng, 2011). This challenge is particularly relevant for agent-based models, which are used to simulate complex phenomena (Grimm et al., 2006, 2020). One effective strategy to address this issue is the development of open, specialized tools that enhance transparency and promote standardization and reusability among researchers (Berger et al., 2024; Ram et al., 2019). This is why `LogoClim` was created.

The `LogoClim` model was developed for seamless integration with other models through NetLogo's `LevelSpace` extension (Hjorth et al., 2020), which enables parallel execution and data exchange between models. This integration capability makes it particularly valuable for agent-based simulations that incorporate climate data to study ecological, environmental, or social processes affected by climate conditions.

The model was originally developed as part of a project by the Sustentarea Research and Extension Center, aimed at evaluating the impact of climate change on the health and nutrition of Brazilian children under five years old (Carvalho et al., 2023). Over the course of its development, however, we realized that its applications extend well beyond the scope of the study.

While other programming languages, such as R, offer tools like the `geodata` package (Hijmans et al., 2024), there are currently no equivalent tools providing this functionality for NetLogo.

How it works

`LogoClim` operates on a grid of patches, with each patch representing a geographic area and storing values for latitude, longitude, and selected climate variables. During simulation, patches update their colors based on the underlying data, enabling users to visualize spatial and temporal changes. The model interface also provides plots showing the mean, minimum, maximum, and standard deviation of the selected variable over time.

The model supports all three climate data series from WorldClim 2.1: long-term historical climate averages (1970-2000), historical monthly weather (1951-2024), and future climate projections (2021-2100). Each series is available at multiple resolutions, ranging from 10 minutes, about 340 km^2 at the equator, down to 30 seconds, about 1 km^2.

The datasets are available for download from WorldClim 2.1, but must be converted to Esri ASCII format for compatibility with NetLogo. We provide tools to automate and simplify the conversion process, which are described in the model user manual.

We also provide example datasets for testing and demonstration. These files are available in the model OSF repository and are ready to use with `LogoClim`. To illustrate how `LogoClim` can be used in practice, we also developed the `Logônia` model (Vartanian et al., 2026), which showcases its integration into a full NetLogo simulation.

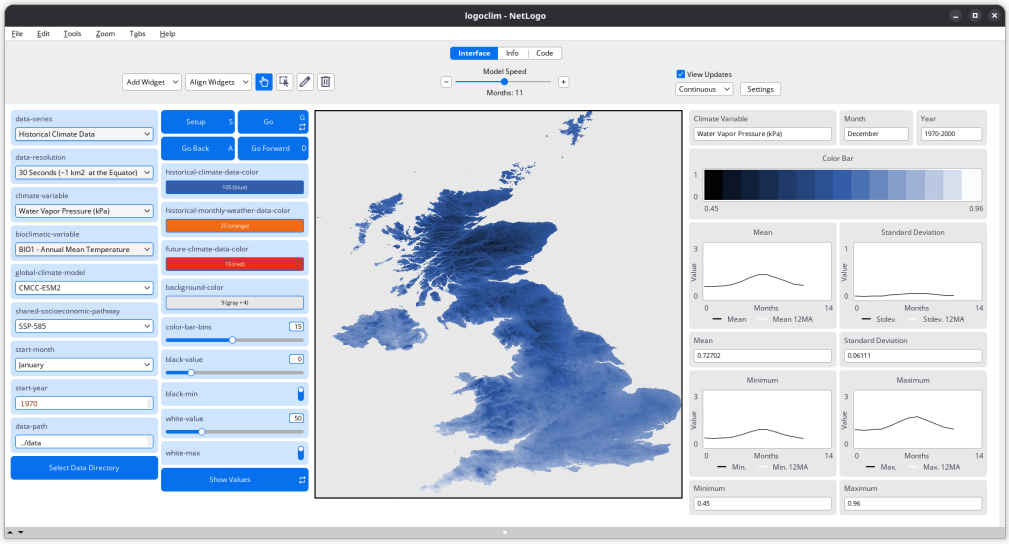

Figure 2: LogoClim Graphical User Interface: United Kingdom.

Acknowledgements

We gratefully acknowledge Stephen E. Fick, Robert J. Hijmans, and the entire WorldClim team for their outstanding work in creating and maintaining the WorldClim datasets. `LogoClim` is an independent project with no affiliation to WorldClim or its developers. Users should note that WorldClim datasets are freely available for academic and other non-commercial use only. Any use of WorldClim data within `LogoClim` must comply with WorldClim's licensing terms.

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